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(54) INK JET RECORDER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an ink jet printer in which recovery ejection (priming) is performed optimally depending on the environment.

SOLUTION: A controller 15 measures relative humidity, at first, upon receiving a print start signal (S1), and determines a required priming interval T1 based on the measured relative humidity and a humidity.T1 table stored in a second ROM 22 (S2). Subsequently, priming is performed for all orifices 7 prior to printing (S3), a timer TM is set at '0' and measurement of the time TM elapsed after priming is started (S4) before one main scanning line is printed (S5). A decision is then made whether printing of all lines has ended or not (S6), and if the answer of 86 is NO, a decision is made whether 'T1>TM+TK' is satisfied or not (S7) where TM is the time elapsed after previous priming, TK is the print time of next main scanning line and T1 is the required priming interval. If the answer of S7 is YES, next main scanning line is printed and if S7 is NO, priming is performed at S3 prior to printing and then S4-S6 are performed. If S6 is YES, processing is ended.

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CLAIMS

[Claim(s)]

[Claim 1] The ink jet printer characterized by to have a regurgitation spacing modification means change priming spacing perform for a long time than priming spacing memorized by said storage means when the humidity detected by the regurgitation means which carries out the regurgitation of the ink, detection means detect the humidity near this regurgitation means, storage means memorize priming spacing in criteria humidity, and said detection means is high than said criteria relative humidity.

[Claim 2] The ink jet printer characterized by to have a regurgitation spacing modification means change priming spacing perform short than priming spacing memorized by said storage means when the temperature detected by the regurgitation means which carries out the regurgitation of the ink, detection means detect the temperature near this regurgitation means, storage means memorize priming spacing in reference temperature, and said detection means is high than said reference temperature.

[Claim 3] The ink jet printer characterized by to have the regurgitation control means which makes ink breathe out at intervals of the priming beforehand decided to be the

regurgitation means which carries out the regurgitation of the ink, and a discharge-condition detection means detect whether the regurgitation of said ink was performed normally, and a regurgitation spacing modification means change priming spacing by said regurgitation control means for a long time when it is detected that the regurgitation of said ink was normally performed by said discharge-condition detection means.

[Claim 4] Said regurgitation control means is an ink jet printer according to claim 3 characterized by dividing said regurgitation means into two or more groups, and carrying out regurgitation control.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ink jet printer which performs the recovery regurgitation the optimal according to an environment.

[0002]

[Description of the Prior Art] Conventionally, the printer of an ink jet method occurs. There are a thermal ink jet method which flies an ink droplet by the mosquito which air bubbles generate, a piezo ink jet method which flies an ink droplet according to deformation of a piezoresistive element (piezoelectric device) in the printer by this ink jet method.

[0003] these printers -- color material -- the description which was [constitute / the main frame / printing energy is small economical, colorization by mixing of ink is easy, there is also little noise, and / it prints by making ink into an ink droplet and carrying out the regurgitation toward a direct record form (printing), and / by this, / small] excellent -- **** -- since it is, it is especially used widely as a printer for personal (printer).

[0004] However, the ink delivery (regurgitation nozzle) of a print head where the printer of such an ink jet method carries out the regurgitation of the ink is always exposed to the open air. and the voice of the alphabetic character (or it is the same as that of the image to print and the following) in which all regurgitation nozzles do not carry out the regurgitation of the ink, and print it just because it is under printing -- if it depends like, even if it is under printing, it is not new that the regurgitation (it is not necessary to carry out regurgitation) nozzle which does not carry out the regurgitation of the ink over comparatively long time amount occurs.

[0005] if especially a print head turns into a print head equipped with many regurgitation nozzles by the long picture like a Rhine style print head -- the print head

of a serial type -- comparing -- the count of the regurgitation per 1 regurgitation nozzle -- being few (a regurgitation probability being) -- the regurgitation nozzle which does not carry out the regurgitation of the ink once during 1-page printing depending on printing data is also generated.

[0006] If it does so, the ink which is standing still and piling up over long duration in the regurgitation nozzle for which the regurgitation of ink was not performed will dry and thicken, and the problem that the regurgitation nozzle starts blinding will occur. The time when especially operating environment temperature is high, and when operating environment humidity is low, it dries for a short time and blinding becomes easy to generate ink. In order to cancel this blinding, the printer of an ink jet method is performing actuation called the so-called recovery regurgitation (priming) which eliminates the ink which thickened also during printing as well as the time of printing initiation by performing the regurgitation of ink which does not participate in printing from a regurgitation nozzle.

[0007] It is beforehand set as fixed spacing and, as for the printer, priming actuation is performed comparatively frequently during printing according to that set-up priming spacing so that bad influences, such as blinding by thickening which was mentioned above, may not generate the timing which performs this priming, i.e., priming spacing, under all the operating environments of a printer.

[0008]

[Problem(s) to be Solved by the Invention] By the way, supposing the worst case in operating environments, such as aging of a print head, manufacture dispersion or temperature, and humidity, etc., allowances (margin) are given and the above-mentioned priming spacing is decided to be able to respond, also when [that] the worst. Therefore, in many cases, priming spacing becomes short beyond the need and priming actuation will occur frequently during printing as mentioned above.

[0009] Therefore, it had various problems [say / that the frequent priming actuation under above-mentioned printing reduces the throughput of a printout sharply, and causes the life fall of a print head, the consumption of the ink further used for a priming becomes large, and the printer of the conventional ink jet method is uneconomical].

[0010] The technical problem of this invention is offering the ink jet printer which performs a priming the optimal according to an operating environment in view of the above-mentioned conventional actual condition.

[0011]

[Means for Solving the Problem] Below, the configuration of the ink jet printer concerning this invention is described. First, the ink jet printer of invention according to claim 1 When the humidity detected by the regurgitation means which carries out the regurgitation of the ink, detection means to detect the humidity near this regurgitation means, storage means to memorize priming spacing in criteria humidity, and the above-mentioned detection means is higher than the above-mentioned criteria relative

humidity, It has a regurgitation spacing modification means to change priming spacing to perform for a long time than priming spacing memorized by the above-mentioned storage means, and is constituted.

[0012] Next, when the temperature detected by the regurgitation means which carries out the regurgitation of the ink, detection means detect the temperature near this regurgitation means, storage means memorize priming spacing in reference temperature, and the above-mentioned detection means is high than the above-mentioned reference temperature, the ink jet printer of invention according to claim 2 has a regurgitation spacing modification means change priming spacing perform short than priming spacing memorized by the above-mentioned storage means, and is constituted.

[0013] Furthermore, the ink jet printer of invention according to claim 3 The regurgitation means which carries out the regurgitation of the ink, and a discharge-condition detection means to detect whether the regurgitation of the above-mentioned ink was performed normally, It has the regurgitation control means which makes ink breathe out at intervals of the priming decided beforehand, and a regurgitation spacing modification means to change priming spacing by the above-mentioned regurgitation control means for a long time when it is detected that the regurgitation of the above-mentioned ink was normally performed by the above-mentioned discharge-condition detection means, and is constituted. And like for example, claim 4 publication, the above-mentioned regurgitation control means is constituted so that the above-mentioned regurgitation means may be divided into two or more groups and regurgitation control may be carried out.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing. Drawing 1 (a), (b), and (c) The print head of the ink jet printer in the gestalt of the 1st operation is shown, and the print head of the thermal ink jet method of the top shooter mold (or it is also called a roof shooter mold) of a configuration of carrying out the regurgitation of the ink in the direction perpendicular to the exoergic side of the heating element made to generate the air bubbles for flying an ink droplet is shown typically. This drawing (a) It is the top view of the ink regurgitation side (orifice plate) of a print head, and is this drawing (b). This drawing (a) It is the enlarged drawing in which seeing through an orifice plate and showing the principal part of the internal configuration of the part shown with a broken line A, and is this drawing (c). This drawing (a) It is a B-B' cross-section view enlarged drawing.

[0015] This drawing (a), (b), and (c) The heating element 2 is formed on the silicon substrate 1, the pressurized room 5 according to the ink passage 4 and an individual with a height of 10 micrometers is about formed of a septum 3 and 3-1, and the laminating of the orifice plate 6 is carried out on it so that it may be shown. The orifice 7 as an ink regurgitation means is drilled in the location which counters a heating element 2 by the orifice plate 6. Moreover, the ink supply slot 8 is drilled in the

front-face side of a silicon substrate 1 by about 2 / about five depth from a front face, it is open for free passage into this ink supply slot 8, and the ink feed holes 9 penetrated at the rear face of a silicon substrate 1 are drilled.

[0016] In addition, an orifice 7 is this drawing (b) removing and showing an orifice plate 6 since it is formed in an orifice plate 6. Although an orifice 7 does not exist then, in order to show physical relationship with a heating element 2, the broken line shows the orifice 7. Moreover, for the above-mentioned heating element 2, it connects with the non-illustrated electrode, the ink feed holes 9, the ink supply slot 8, and the ink passage 4 are minded [in which the heating element 2 is formed / 5], and ink is this drawing (c) from the outside. Firm gas is carried out in the direction shown by the broken-line arrow head C.

[0017] There is the approach of forming in a monolithic collectively the drive circuit which carries out the exoergic drive of two or more heating elements, orifices corresponding to these, and heating elements separately as a process of the print head in this format using a silicon LSI formation technique and thin film coating technology.

[0018] If it is the print head whose resolution is 300 dots / 25.4mm at a substrate with a width of face of 15mm, for example according to this approach, 150 heating elements, drive circuits, and orifices will be formed, and if it is the case where resolution is 600 dots / 25.4mm, 300 heating elements, drive circuits, and orifices will be formed. Furthermore, if an orifice train is constituted in four trains corresponding to full color printing, 1200 heating elements, drive circuits, and orifices will be formed.

[0019] Drawing 2 (a), (b), and (c) It is drawing showing ink discharging of the above-mentioned print head typically. this drawing -- drawing 1 (a), (b), and (c) the same component as the shown configuration -- drawing 1 (a), (b), and (c) The same number is given and shown.

[0020] First, drawing 2 (a) In the shown standby condition, the ink 11 currently supplied to the ink passage 4 from the exterior enters in an orifice 7, and forms meniscus 11a by up opening of the orifice 7 along the top face of an orifice plate 6.

[0021] Next, when the heating element 2 corresponding to the orifice 7 chosen as a printing dot according to image information generates heat by energization, many nucleus air bubbles are generated in the interface of a heating element 2 and ink 11, the nucleus air bubbles of these large number coalesce, and it is drawing (b). The film air bubbles 12 are generated so that it may be shown.

[0022] These film air bubbles 12 carry out adiabatic expansion, it grows up, ink 11b is extruded by push **** and this from an orifice 7 in surrounding ink 11, and this extruded ink 11b is this drawing (c) further. It is set to ink droplet 11c, and is breathed out towards a non-illustrated record medium from an orifice 7 so that it may be shown.

[0023] Then, it contracts, the above-mentioned film air bubbles disappear, and the pressurized room 5 which is the arrangement section of the heating element 2 after ink droplet 11c jumps out is supplemented with ink 11 through the ink passage 4 from the

exterior.

[0024] Thus, in the ink JIETO printer of this example which breathes out ink droplet 11c from the orifice 7 of a print head, and performs printing actuation, since ink 11 remains in the orifice 7 of a print head at the time of un-printing In order to prevent deterioration of the increment in viscosity by evaporation desiccation of the ink 11 in this orifice 7 etc., at the time of un-printing, orifice 7 forming face (front face of a print head) of a print head is covered by the non-illustrated cap member, and prevents evaporation desiccation of ink.

[0025] And although it is always necessary to maintain ink 11 at a regurgitation possible condition during a printing period and ink 11 is always filled in the orifice 7 Ink is not breathed out from all the orifices 7 of a print head. Only the orifice 7 with which regurgitation directions are taken out corresponding to printing information mentioned above that the fault which ink carries out evaporation desiccation of the ink in the orifice 7 which regurgitation directions do not have discharge and beyond a certain period, and is thickened arose.

[0026] Therefore, in order to make the ink 11 in which the viscosity in an orifice 7 has become high breathe out and to return all the orifices 7 to a normal discharge condition, it mentioned above that it was also necessary to perform a priming.

[0027] In this example, it controls to perform it corresponding to the relative humidity of the environment where the ink jet printer is installed rather than to perform this priming to the fixed period set up beforehand. Therefore, the humidity sensor is attached in the ink jet printer in the gestalt of this operation near the print head so that it may mention later. It uses for the setup of priming spacing at which a control unit mentions that result later in detail with reference to the output of this humidity sensor.

[0028] Drawing 3 is the block diagram showing the system configuration of the above-mentioned ink jet printer. As shown in this drawing, 1st input/output interface I/O16, the key sensor 17, a process load 18, ROM22 of 21 or 2nd ROM of 19 or 1st RAM, and 2nd input/output interface I/O23 are connected to the control unit 15 of an ink jet printer. In this drawing, it is received by 1st input/output interface I/O16, and by the control device 15, the printing data inputted from the outside are sent to the head unit 24 through 2nd input/output interface I/O23, after data processing is performed.

[0029] the head unit 24 -- drawing 1 (a), (b), and (c) It consists of the humidity sensors 27 and temperature sensors 28 which are arranged in the shown print head (drawing 3 print head 25), the piezoelectric-device arrays 26 (the piezoelectric-device array 26 consists of each piezoelectric devices 10 shown in drawing 1 and drawing 2), and these near. The regurgitation of the ink shown in drawing 2 by the above-mentioned print head 25 is performed.

[0030] The key sensors 17 are input components, such as various input keys and a form detection sensor, and process loads 18 are a form conveyance motor, various kinds of displays, etc. 1st ROM21 is memory which memorizes priming spacing according to

temperature or humidity mentioned later, and priming spacing is determined that it will mention later by the control unit 15 based on the table showing the relation between the temperature and humidity which are memorized by this memory, and priming spacing, and the temperature sensor 28 in the head unit 24 or the measured value of a humidity sensor 27. 2nd ROM22 is memory which memorizes a voltage waveform when a normal voltage waveform and ink plugging have generated the output voltage of the piezoelectric-device array 26 beforehand.

[0031] Drawing 4 is the property table showing the relation between the relative humidity used for the example of the book memorized by 1st ROM21, and priming spacing. Relative humidity is shown on an axis of abscissa by this drawing, and priming spacing is shown on the axis of ordinate. Priming spacing needed when relative humidity becomes high, as shown in this drawing may come to be long. According to the experiment, in the environment where temperature is 25 degrees C, when relative humidity is 25%RH, even if it performs a priming at intervals of 80 seconds, in the time of relative humidity being 45%RH, it has become clear that the normal ink regurgitation is maintainable that what is necessary is just to perform a priming at intervals of 12 seconds.

[0032] Hereafter, the processing actuation by the control unit 15 which controls actuation of a priming using the relation between the above-mentioned relative humidity and priming spacing is explained. In addition, in the following explanation, although the ink jet printer 14 of this example is explained as a serial type printer, of course, it is applicable also to a Rhine style printer equipped with the full array print head.

[0033] Drawing 5 is a flow chart explaining the processing actuation which controls actuation of the priming by the above-mentioned control device. In addition, in this processing, a control unit 15 newly performs setting processing of the need and the spacing T1 (henceforth the need priming spacing T1) of the priming made, referring to the table showing the relation between the relative humidity memorized by 2nd above-mentioned ROM22 and priming spacing. Moreover, the timer TM which clocks the elapsed time TM of the need priming spacing T1 is used for this processing, and the time amount TK required for printing which is horizontal scanning of one line is memorized beforehand in the predetermined storage region of storage. Moreover, in control of this example, since a temperature sensor 28 and a piezoelectric device 10 are not used, it is applicable also to the print head which does not have a temperature sensor 28 and a piezoelectric device 10.

[0034] In this drawing, generating of a printing start signal measures relative humidity first (step S1). In this processing, a humidity sensor drives and that output is referred to. Next, the need priming spacing T1 is determined based on the relative humidity which became clear with the output of the above-mentioned humidity sensor, and the table read from the store (step S2). In this processing, if the measurement result of a humidity sensor is 45%RH, the need priming spacing T1 will be set as 80 seconds, for example.

[0035] And a priming is performed to all the orifices 7 before printing activation (step S3). The ink which is thickening in all the orifices 7 is removed by this, and the normal ink regurgitation of between the need priming spacing T1 becomes possible from all the orifices 7.

[0036] Then, Timer TM is initialized to "0" (step S4). Thereby, the time check of the elapsed time TM after performing the above-mentioned priming is started by Timer TM.

[0037] First, if it distinguishes whether printing of all Rhine that performs printing of horizontal scanning of one line (step S5), next is specified for printing information was completed (step S6) and printing of all Rhine is not completed (S6 is NO), a ply mink distinguishes further whether it is the need (step S7).

[0038] In this processing, the time amount which added the elapsed time TM after carrying out a priming last time, and the time amount TK required for printing of the horizontal scanning of one line as follows distinguishes whether it is smaller than the need [of being set up at step S2] priming spacing T1. In addition, by the serial type printer, this distinction is in the middle of printing of horizontal scanning of one line, and since a priming is not made, it is performed.

[0039] And it is small, namely, by the above-mentioned distinction, when it is "T1>TM+TK", even if (S7 print YES) and the horizontal scanning of one line as follows, it is less than [need priming spacing T1], and since it is convenient, it progresses to processing of the above-mentioned step S5, and printing of the horizontal scanning of one line as follows is performed.

[0040] On the other hand, it winds performing step S4-S6, after shifting to processing of step S3 and performing a priming before printing activation, since the need priming spacing T1 becomes [(S7] progress striped ****** during printing by NO) and having printed the horizontal scanning of one line as follows as it was and it is inconvenient now at the time of "T1 <=TM+TK" by distinction of the above-mentioned step S7, and is ******. And in step S6, a check of that printing of all Rhine was completed ends processing (S6 is YES).

[0041] Thus, since a priming is performed at long spacing of the need [of measuring environmental relative humidity and approving under the environment] maximum, the consumption of the ink which there is no futility in actuation of a priming, therefore the throughput of a printout improves, and the life of a print head is also prolonged, and is further used for a priming falls and is economical.

[0042] In addition, with the gestalt of this operation, although the need priming spacing T1 is decided only with the relative humidity of the print head circumference, with temperature, environmental temperature is measured and this temperature can be used.

[0043] Drawing 6 is the property table showing the relation between the temperature memorized by 1st ROM21 and priming spacing. Temperature is shown on an axis of abscissa by this drawing, and priming spacing is shown on the axis of ordinate. Since desiccation of ink will generally become early if environmental temperature becomes

high, thickening of the ink of an orifice starts for a short time rather than the time when temperature is low. For this reason, it is necessary to perform a priming at shorter spacing as are shown in this drawing and temperature becomes high.

[0044] Anyway, modification of the need priming spacing T1 has three kinds of methods of changing only humidity information based on the information on both temperature information or humidity information, and temperature information, which approach may be used, and a priming can be performed at long spacing of the need [of approving under the environment] maximum.

[0045] Next, processing of the priming spacing decision by the control unit 15 of the ink jet printer 14 in the gestalt of the 2nd operation is described. The piezoelectric device 10 arranged, respectively is used for the wall surface of the septum 3 of each pressurized room 5, i.e., the side of all the heating elements 2, in this processing. In this example, this detects the discharge condition of ink.

[0046] Generally, on the other hand, if an electrical potential difference is impressed to a piezoelectric device, it will deform, and if it deforms in response to external pressure, it will generate an electrical potential difference. Although an ink droplet is made to breathe out from an orifice by the ink jet printer of a piezo type by the pressure which was made to impress and deform an electrical potential difference into a piezoelectric device, and was generated according to the deformation, in this example, the ink discharge condition of each orifice 7 is inspected by what the voltage waveform generated with the external pressure (pressure in a pressurized room 5) which a piezoelectric device 10 receives is taken out for (it detects).

[0047] In this example, the signal (electrical potential difference) wave from the piezoelectric device 10 when [at which it mentioned above] carrying out the ink regurgitation normally is beforehand memorized by 2nd ROM22. When inspecting the ink discharge condition of each orifice 7, it distinguishes whether one orifice 7 was made to breathe out ink at a time in order, the signal wave form detected from a piezoelectric device 10 was compared with the signal wave form at the time of the normal ink regurgitation memorized to storage, and the regurgitation was performed normally.

[0048] That is, when a heating element 2 generates heat, it is drawing 2 (c). The film air bubbles 12 are generated and the pressure of a pressurized room 5 rises so that it may be shown. When there is no plugging of ink 11, the pressure of a pressurized room 5 rises according to generating of the film air bubbles 12 for a moment, and in connection with the regurgitation of ink 11b, a pressure descends immediately.

[0049] However, when ink plugging has occurred, the pressure of a pressurized room 5 rises according to generating of the film air bubbles 12, but in order that ink 11b may not carry out the regurgitation, while it is for a while, a pressure does not fall, but it descends gradually and goes. The difference between the pressure variation at the time of this normal regurgitation and the pressure variation at the time of ink plugging serves

as a wave of the output voltage of a piezoelectric device 10, and appears.

[0050] The voltage waveform when the normal voltage waveform (reference waveform) and ink plugging which this piezoelectric device 10 outputs have occurred is memorized beforehand, and a discharge condition can be detected by comparing with a reference waveform and an ink plugging wave the voltage waveform which the one above-mentioned orifice 7 was made to breathe out ink at a time in order, and was measured.

[0051] In addition, a voltage waveform may memorize only one wave. For example, what is necessary is just to process with abnormalities in the case of normality and an inequality, when only the voltage waveform of forward always is memorized and the generated voltage waveform is in agreement. Conversely, when only the voltage waveform at the time of abnormalities is memorized and the generated voltage waveform is in agreement, in the case of abnormalities and an inequality, you may process that it is normal.

[0052] Moreover, if it inspects with the processing speed of 10kHz even if the above-mentioned regurgitation inspection has 1000 orifices 7, inspection will end it in small 0.1 seconds about all orifices.

[0053] Thus, the ink discharge condition of each orifice 7 is inspected, and the need priming spacing T1 is determined based on the inspection result. Drawing 7 is a flow chart explaining the processing actuation which controls actuation of the priming by the control device 15 of the ink jet printer 14 in the operation gestalt of the above 2nd. In addition, in the processing in this example, the priming spacing variable n is used as a processing variable, and the time amount TA required for the output for one sheet of desired print form is set up beforehand.

[0054] In this drawing, generating of a printing start signal substitutes 5 for the priming spacing variable n as initial value first (step S11). Thereby, the time amount for 5 seconds is set up for the time being as spacing to the following priming.

[0055] Next, after performing a priming, making a regurgitation possible condition recover all the orifices 7 (step S12) and standing by for n seconds (it is 5 seconds at first) (step S13), all nozzle regurgitation is processed shortly (step S14). Processing of all these nozzle regurgitation is processing which inspects whether ink (ink droplet 11c) was normally breathed out from all the orifices 7 with reference to the signal wave form detected from a piezoelectric device 10, making one orifice 7 breathe out ink at a time in order.

[0056] Here, when it is distinguished that the normal regurgitation was not performed, (S14 set the value "n-5" which subtracted "5" from the priming spacing variable n as NO) and the need priming spacing T1 (step S15), and end processing.

[0057] At first, since the priming spacing variable n is "5", by processing of "0" S15, i.e., the above-mentioned step, as for "n-5", "0" is set to the need priming spacing T1. In T1=0, since it is nonprintable, a user is notified of exchange of a print head etc.

[0058] Moreover, that the normal regurgitation is not made after the first priming and 5 seconds as mentioned above shows that the ink thickened in the orifice 7 by the first priming remains, and this shows that it is not in the condition that a print head performs the regurgitation of normal ink any longer. Above T1=0 shows that.

[0059] On the other hand, when it becomes clear by distinction of the above-mentioned step S14 that ink was normally breathed out from all the orifices 7, it distinguishes whether as for YES), then the above-mentioned priming spacing variable n, (S14 are smaller than the time amount TA required for the output for one sheet of form (step S16).

[0060] Usually, since printing of one sheet of form takes the time amount for 5 seconds or more be [it / at first / "TA>n"] (S16 is YES), in this case, "5" increment of the priming spacing variable n is carried out (step S17), it returns to step S12, and steps S12-S14 are repeated again.

[0061] In addition, in this 2nd processing, the priming spacing variable n is 10 seconds. That is, spacing of a priming is extended per 5 seconds. And it repeats performing a priming at step S12 again, standing by for n seconds at step S13, and inspecting whether the regurgitation of all nozzles is normal at step S14.

[0062] And when distinction is YES at step S14 and distinction is set to NO at step S15 If 1 time will not have a priming, either, while meaning that the priming spacing n was prolonged beyond the printing time amount TA for one sheet of form and printing in one sheet of form in this way Even if it lengthens need priming spacing T1 more than this, in order for the throughput which prints one sheet of form not to improve, (step S18) and processing are ended as "T1=n."

[0063] Moreover, by all last nozzle regurgitation inspection that was 5 seconds shorter than now, when distinction of step S14 is set to NO in the printing time amount TA for one sheet of form by processing of the above-mentioned repeat, since it was normal, processing is ended as "TA=n -5" at step S15 in this case. In addition, unlike the time of the beginning, it is "n-5!=0" in this case.

[0064] In this example, the need priming spacing T1 can be set as the optimal, longest possible time amount as mentioned above corresponding to all, such as dispersion in the regurgitation property of orifice each, dispersion at the time of the works production for every printer body, or an environmental change.

[0065] In addition, although it is inspecting whether the normal regurgitation of ink can be performed using all orifices in this example, the number which did not make the number of the orifices to inspect all, but reduced it suitably performs, and you may make it judge probable.

[0066] Drawing 8 is a flow chart explaining the processing actuation which controls actuation of the priming by the control device 15 in the gestalt of the 3rd operation. In addition, in this example, although the number of orifices is blocked and a discharge condition is inspected, the number of the orifices 7 in a print head is made into 100

pieces, and is made into 1 block every ten pieces. That is, all the orifices 7 of the print head of this example form ten blocks which consist of a block "0", blocks "1", ..., blocks "9." Moreover, there shall be no variation in the dryness of ink to each orifice 7. Moreover, in this processing, the block variable k and the priming variable t are used.

[0067] In this drawing, if a printing start signal occurs, "0" clearances of the block variable k will be carried out first, and the priming variable t will be further set as "5" (step S21). Then, the priming of the block "k" is carried out (step S22). At first, since the block variable k is initialized by "0", the priming of the block "0" will be carried out.

[0068] Next, after carrying out standby for t seconds (this example 5 seconds) (step S23), it distinguishes that it is k= 9, or [that is,] it was finished whether carrying out the priming of all of ten blocks (step S24). And if it has still finished carrying out the priming of all of ten blocks (S24 is NO), "1" increment of the block variable k is carried out (step S125), and return and steps S22-S25 are repeated to step S22. Thereby, the priming of ten blocks is carried out at intervals of t seconds one by one.

[0069] And in step S24, if it distinguishes having ended the priming about all ten blocks (S24 is YES), it will inspect whether it is possible to perform the ink regurgitation with all normal orifices (whole block) (step S26). This processing is the same as processing of step S14 in drawing 7 .

[0070] At the time of the processing in this step S26, ****** Li t seconds when the last block "9" carried out the priming have passed, and tx 10 seconds of a block "0" have passed. When elapsed time of this block "k" is set to T [k], the elapsed time from the priming of each block is expressed with the following formulas.

[0071]

T [k] =(10-k) xt ..... (1)

The orifice 7 which was not able to do the regurgitation of normal ink exists here as a result of the above-mentioned inspection (for example, the inside of a block "0"), and suppose that the regurgitation of ink was able to be altogether carried out to normal by block "9" from the other block "1."

[0072] formula (1) then, the passing [the longest time amount] block after carrying out a priming in a block "9" from the block "1" which was able to perform the regurgitation of ink normally is a block "1" of the smallest number in the block which performed the normal regurgitation, and boil the elapsed time of this block "1" -- they are Li and a "T[1] =9xt" second. For example, since it is referred to as "t= 5" by initial setting in this example, it is "T[1] =45" second. Therefore, these 45 seconds are determined as need priming spacing T1 (step S27).

[0073] In addition, although the priming variable t is initialized to "5", if the priming variable t is fixed with this initial setting, the greatest need priming spacing T1 will be fixed to 50 seconds when a whole block performs the normal regurgitation. Thus, priming spacing is still longer when it is checked that all the orifices had been breathed out normally.

[0074] Therefore, if the optimal priming variable t is set up repeatedly suitably, making [make the priming variable t into 6 seconds from 5 seconds, inspect, and] the above-mentioned processing increase by one by one with ... for 7 seconds and 8 seconds if normal When a poor regurgitation nozzle occurs temporarily at the time of 8 seconds, 7-second spacing before that is the optimal, namely, can set up 57 seconds as need priming spacing T1 in consideration of margin 10% for 7 second x9 nozzle = 63 seconds in this case. Thus, the longest need priming spacing T1 according to an environment can be determined.

[0075] Moreover, processing which determines the need priming spacing T1 in the gestalt of the 1st - the 3rd operation mentioned above may be performed at fixed spacing during every printing termination and printing standby before a power up and printing initiation. Moreover, it has a temperature sensor and a humidity sensor, and it may be made to carry out when it is detected that the environment changed a lot. Furthermore, the processing which determines the above-mentioned need priming spacing T1 is called at the time of exchange of a print head, the time of test printing, etc., and you may make it decide the need priming spacing T1 to be them.

[0076] However, since the viscosity of ink may be high when carrying out at fixed spacing during printing standby, and the spacing is long, it is desirable to expect a margin and for ** to decide the need priming spacing T1 to be an eye for a while. It is good to expect 10% of margin and to determine 41 seconds (45 second x0.9) as need priming spacing T1 by the processing shown in above-mentioned drawing 8 as an example, when the longest T [K] becomes 45 seconds.

[0077] By the way, although new need priming spacing T1 was set up with the gestalt of the 1st operation, referring to the table showing the relation between relative humidity and priming spacing, the table itself which shows the relation between relative humidity and priming spacing was still immobilization. However, if the self-amendment function corresponding to change of environmental humidity is added to the above-mentioned table, the need priming spacing T1 which was much more well adapted for the environment can be obtained. Hereafter, this is explained as a gestalt of the 4th operation.

[0078] Drawing 9 is a flow chart explaining the processing actuation which controls actuation of the priming by the control device of the ink jet printer in the gestalt of the 4th operation. The processing shown in this flow chart is a self-amendment routine called to un-printing at the time of standby etc. by having predetermined spacing.

[0079] By this self-amendment routine, the relative humidity near the print head is measured first (step S31). Then, the need priming period T1 is determined (step S32). In this decision processing, the need priming period T1 is determined by the approach shown with the gestalt of the 2nd or the 3rd operation.

[0080] For example, at the time of factory shipments, the relative humidity near the print head and the relation of the need priming period T1 are stored in the storage of the

body of equipment as a table of relative humidity and T1 need priming period, after considering the value which amended each variation of an ink jet printer.

[0081] T1' which had a predetermined margin to T1 of the new need [of being extracted from this table beforehand stored in the store of the body of equipment based on the relative humidity measured at the above-mentioned step S31] priming period is computed, and the table of the early relative humidity and need priming period T1 is rewritten based on this T1' (step S33).

[0082] For example, also when a user demands refresh of a print head, this self-amendment routine is called. When a user demands refresh of a print head, it is a time of not being satisfied with a printing result, for example, is a time of the orifice 7 having started blinding in thickening ink etc. After refreshing a print head by sufficient priming actuation at this time, the self-amendment routine shown in drawing 9 is called, and T1' determined by this processing is preferentially embedded in relative humidity and need priming period T1 table. Or weighting by above-mentioned T1' is carried out, and the whole table is re-calculated.

[0083] The margin or weight to an initial table is determined by the need [of having been determined by the approach to which relative humidity and need priming period T1 table on which relation was being fixed in drawing 4 showed with the gestalt of the 2nd or the 3rd operation, and was based on the reliance actual condition by this] priming period, and the early table comes to be serially amended by this margin or weight.

[0084] In addition, in the processing shown in drawing 9 , although only humidity was measured, temperature may also be measured and a table may be rewritten similarly. Although relative humidity explained detection of humidity, and amendment of priming spacing in the above example, even if detection of humidity uses absolute humidity, it is needless to say that this application is applicable.

[0085]

[Effect of the Invention] Since priming spacing under printing is set up the optimal corresponding to one line or the printing time amount of one sheet according to this invention as explained to the detail above, the throughput of a printout can be raised, and the life of a print head can be prolonged, and the consumption of ink can be reduced.

[0086] Moreover, since a need priming spacing decision program is called at the time of refresh of the print head by predetermined spacing or a predetermined user, and test printing and the always optimal need priming spacing is decided to the operating environment of the body of equipment, or aging of a print head, fastest-ization with a more high precision is performed, and reinforcement of much more print head and reduction-ization of ink consumption are realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] (a) The top view of the ink regurgitation side of the print head of the ink jet printer in the gestalt of operation of **** 1, and (b) The enlarged drawing and (c) which see through an orifice plate and show the principal part of the internal configuration (a) It is a B-B' cross-section view enlarged drawing.

[Drawing 2] (a), (b), and (c) It is drawing showing typically ink discharging of the print head in the gestalt of the 1st operation.

[Drawing 3] It is the block diagram showing the system configuration of the ink jet printer in the gestalt of the 1st operation.

[Drawing 4] It is the property table showing the relation between the relative humidity used in the gestalt of the 1st operation, and priming spacing.

[Drawing 5] It is a flow chart explaining the processing actuation which controls actuation of the priming by the control device of the ink jet printer in the gestalt of the 1st operation.

[Drawing 6] It is the property table showing the relation between the temperature used in the gestalt of the 1st operation, and priming spacing.

[Drawing 7] It is a flow chart explaining the processing actuation which controls actuation of the priming by the control device of the ink jet printer in the gestalt of the 2nd operation.

[Drawing 8] It is a flow chart explaining the processing actuation which controls actuation of the priming by the control device of the ink jet printer in the gestalt of the 3rd operation.

[Drawing 9] It is a flow chart explaining the processing actuation which controls actuation of the priming by the control device of the ink jet printer in the gestalt of the 4th operation.

[Description of Notations]

1 Silicon Substrate
2 Heating Element
3 3-1 Septum
4 Ink Passage
5 Pressurized Room
6 Orifice Plate
7 Orifice
8 Ink Supply Slot
9 Ink Feed Holes
10 Piezoelectric Device
11 Ink
11a Meniscus

11b Ink
11c Ink droplet
12 Film Air Bubbles
14 Ink Jet Printer
15 Control Unit
16 1st Input/output Interface I/O
17 Key Sensor
18 Process Load
19 RAM
21 1st ROM
22 2nd ROM
23 2nd Input/output Interface I/O
24 Head Unit
25 Print Head
26 Piezoelectric-Device Array
27 Humidity Sensor
28 Temperature Sensor